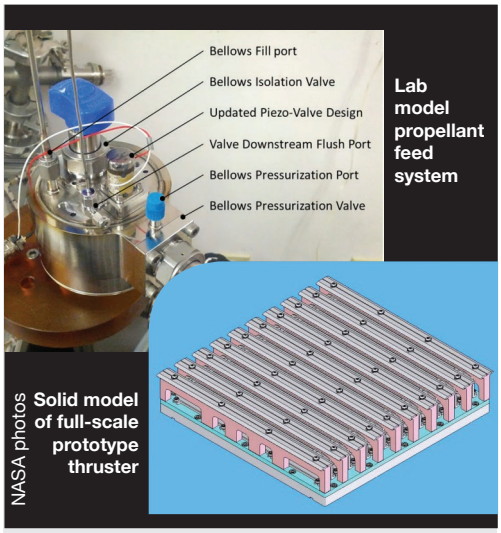
20-mN Variable Specific Impulse (Isp) Colloid Thruster

For colloid-based, multimode propulsion using ionic liquids

Busek Company, Inc., has designed and manufactured an electrospray emitter capable of generating 20 mN in a compact package (7x7x1.7 in). The thruster consists of nine porous-surface emitters operating in parallel from a common propellant supply. Each emitter is capable of supporting over 70,000 electrospray emission sites with the plume from each emitter being accelerated through a single aperture, eliminating the need for individual emission site alignment to an extraction grid. The total number of emission sites during operation is expected to approach 700,000.

This Phase II project optimized and characterized the thruster fabricated during the Phase I effort. Additional porous emitters also were fabricated for full-scale testing. Propellant is supplied to the thruster via existing feed-system and microvalve technology previously developed by Busek, under the NASA Space Technology 7's Disturbance Reduction System (ST7-DRS) mission and via follow-on electric propulsion programs. This project investigated methods for extending thruster life beyond the previously demonstrated 450 hours. The life-extending capabilities will be demonstrated on a subscale version of the thruster.



Applications

NASA

- Missions requiring exceptional thrust/power where power is limited
- Missions benefiting from variable Isp (200 to 2,000+ s) and variable thrust (10x throttling)

Commercial

- Colloid-based multimode propulsion using ionic liquids, where there is a lack of suitable thrusters at the millinewton level or greater
- Replacement for lower thrust plasma-based electric propulsion devices, which suffer from decreased efficiency at low power due to unfavorable surface-to-volume scaling
- Spacecraft requiring both dwell/station keeping and rapid maneuvers from a single propulsion system

Phase II Objectives

- Validate Busek's concept for scaling electrospray thrust to the 20-mN level through self-organized electrospray emission from porous surfaces
- Develop a thruster package that is compact, robust, and does not require complicated manufacturing techniques
- Optimize the design for best performance and improve the total impulse achievable through increased thruster lifetime

Benefits

- Offers a compact, robust package
- Potential future use of shared propellant tanks for high-thrust chemical propulsion as well as high Isp electric propulsion
- Enables new classes of missions benefiting from variable Isp of 200 to 5,000+ s and variable thrusts up to and exceeding 20 mN

Firm Contact

Busek Company, Inc.
Nathaniel Demmons
nate@busek.com
11 Tech Circle
Natick, MA 01760–1023
Phone: 508–655–5565

Proposal Number: 10-2 S3.04-8878